SPECIFICATION

TITLE OF THE INVENTION :

ROTARY ENGINE AND COMPRESSOR

INVENTOR'S NAME :

HOJJAT FATHOLLAHI

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Inventor's name : Hojjat Fathollahi

Date of birth : Sep 21,1966

Country : Iran

Citizenship : Iranian

Title of the invention : Rotary Engine and Compressor

CROSS-REFERENCE TO RELATED APPLICATIONS

Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING COMPACT DISK APPENDIX

Not Applicable

FIELD OF THE INVENTION

[0001] This invention is related to any engineering field wherein an internal combustion engine can be used to drive a system , such as automotive engineering and aircraft engineering ,or wherein a compressor can be used to compress a fluid.

HISTORY OF INVENTIONS IN INTERNAL COMBUSTION ENGINES

[0002] The first internal-combustion engine was designed by the Dutch scientist Christian Huygens in 1678 and was to be fueled with gunpowder, but it was never built. In about 1860 a French inventor, Etienne Lenoir, built the first practical internal-combustion engine which burned illuminating gas. In 1866 two German engineers, Eugen Langen and Nikolaus August Otto, developed a more efficient

gasoline engine, and in 1876 Otto built a four-cycle engine, a prototype of the so-called Otto-cycle engines used in most modern automobiles and airplanes.

[0003] Rotary engines were known as early as 1588, following the development of a rotary engine design by Ramelli. Various rotary engine designs were proposed during the late 1800's following the development of the four stroke Otto cycle engine in 1876. Rotary engine designs enjoyed popularity in aviation applications at the time of World War I. These engines were primarily air-cooled, with cylinders arranged radially around a crankshaft that was fastened to the fuselage.

[0004] The most successful rotary engine has been the Wankel engine , developed by the German engineer Felix Wankel in 1956 .Following Wankel's development of various rotary engines, Curtiss-Wright licensed rotary engine technology from Wankel GmbH in 1958. Curtiss-Wright began an aggressive research program into the various applications of rotary engines, including automotive and other applications. Curtiss-Wright, however, did not develop a commercially viable rotary engine . Instead, in 1984, Curtiss-Wright sold its rotary engine division to John Deere. Deere proceeded to do additional research on stratified charge, rotary engines.

[0005] Numerous engine manufacturers and automotive companies have attempted to develop commercial rotary engines including: Curtiss Wright, John Deere, Rotary Power International, Mazda, NSU (Germany), Audi, General Motors, Ford, and Nissan. With the exception of Mazda, each has tried and failed to achieve a commercially successful rotary engine .

[0006] Till now ,many kinds of engines have been invented , but from a commercial point of view , the absolute majority of engine usage is with conventional reciprocating internal combustion engines in comparison with any type of rotary internal combustion engine.

OBJECTS OF THE INVENTION

[0007] It is an object of a preferred embodiment of the present invention to achieve a new rotary engine design , wherein the engine based on this concept be able to compete with conventional reciprocating engines from a commercial point of view .

[0008] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design for achieving lower engine cost in comparison with the Wankel engine .

[0009] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design to improve sealing and lubrication in the areas of the inner surface of the casing and the outer surface of the rotor .

[0010] It is an object of a preferred embodiment of the present invention to provide a new rotary engine of small size.

[0011] It is an object of a preferred embodiment of the present invention to provide a new rotary engine of light weight .

[0012] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design to improve engine power in comparison with conventional reciprocating four-stroke internal combustion engines.

[0013] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design to improve engine torque in comparison with conventional reciprocating four-stroke internal combustion engines.

[0014] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design of low complexity .

[0015] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design with ease of manufacturing .

[0016] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design with ease of assembly .

[0017] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design with a statically balanced rotor .

[0018] It is an object of a preferred embodiment of the present invention to provide a new rotary engine design with a dynamically balanced rotor .

SUMMARY OF THE INVENTION

[0019] An internal combustion rotary engine comprising : a casing defining a cylindrical chamber , end covers that support the main engine shaft and are securely fixed on the casing, a rotor with an output shaft as the main engine shaft in the said cylindrical chamber , piston chambers and rotationally reciprocating pistons in the rotor , planet gears on the rotor that rotate around their own axes as well as the main shaft axis where the said planet gears also play the role of a reciprocating engine crank shaft in said new rotary engine , piston rods that connect pistons to planet gears where the planet gears are mating with a sun gear(s) fixed to the engine block on one or both side(s) of the casing .The rotation of the planet gears around their axes at combustion stroke causes them to move on the sun gear and causes the rotor to rotate around its shaft axis .

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] All figures pertain to a rotary engine with n=1 (n is the number of complete working strokes per revolution of the main shaft for each piston) , plant gears mounted on one side of the rotor ;and the engine comprises : rotor assembly , casing assembly , right hand end cover assembly and left hand end cover assembly .Dimensions of all components are comparable with each other , except for the zoomed views .

[0021] Table 1 shows the engine parts list including part numbers for all engine assemblies , subassemblies and components .

[0022] Figures 1a and 1b show complete assembly of the engine .

[0023] Figure 2 shows a cutaway drawing of the rotary engine .

[0024] Figures 3a and 3b show complete assembly of the rotor .

[0025] Figures 4a and 4b show the right hand end cover assembly .

[0026] Figures 5a and 5b show the left hand end cover assembly .

[0027] Figures 6a and 6b show the casing assembly .

[0028] Figure 7 shows an exploded view of the rotor assembly.

[0029] Figure 8 shows an exploded view of the right hand end cover assembly.

[0030] Figure 9 shows an exploded view of the left hand end cover assembly .

[0031] Figure 10 shows an exploded view of the casing assembly .

[0032] Figures 11 through 48 show the rotor assembly components separately.

[0033] Figures 49 through 57 show the casing assembly components separately.

[0034] Figures 58 through 62 show the left hand end cover assembly components separately.

[0035] Figures 63 and 64 show the right hand end cover assembly components separately.

[0036] Figures 65 through 73 show how the rotary engine works .

[0037] Figures 74 through 81 show cross sections of the engine .

[0038] Figures 82 through 87 show more-detailed views of the piston front and the piston side seals and the seal seats on the piston head .

DETAILED DESCRIPTION OF PREFERED EMBODIMENTS

[0039] Rotor assembly 1000 further comprises : chamber subassembly 1100, planet gear subassembly 1200 and shaft subassembly 1300 .

[0040] Shaft subassembly 1300 comprises : main shaft 1301 (rotor shaft), lubrication hole obturator 1308 and a lock mechanism including cotter pin 1302 ,slotted nut 1303 ,washer 1304 ,spring 1305 ,lock tongue 1306 and lock lever 1307 in order to lock chamber subassembly from moving along the shaft axis (refer to Figures 75 and 80) . The main shaft has one main radial hole to receive oil from LH end cover assembly 3000 (refer to Figure 75) .There is a small longitudinal groove at the place of this hole on the outer surface of the shaft to lubricate the shaft bearing .The oil enters a longitudinal hole at the center of the shaft and goes for five radial holes of which one is for the lubrication of the shaft bearing at RH end cover assembly 4000 and the other four are for supplying oil to chamber subassembly 1100 (refer to Figure 81).

[0041] Planet gear subassembly 1200 comprises : planet gear 1202 mounted on a small shaft which is part of planet gear support 1204 by using a retaining ring 1201 . All the gear subassemblies are located precisely on LH chamber side 1114 by using planet gear support locator pins 1203 (refer to Figure 79) and then mounted securely . Gears 1202 are meshed with a sun gear 3107 on LH end cover assembly 3000 (refer to Figures 77 and 79).

[0042] Chamber subassembly 1100 comprises : four pistons 1108 and their related seals and springs named piston rear seals 1109 ,piston front seals 1110 ,piston side seals 1111, piston RR & FR seal springs 1112 and piston side seal springs 1113 (all these seals are used to prevent gas leakage ; Figures 82 to 87 show how front seal 1110 and piston side seal 1111 provide sealing at the place where these seals meet

each other , and hence no corner seal is required) , four piston pins 1117 as piston rotation axes , four piston pin retaining rings 1102 in order to keep piston pins 1117 in their positions , LH chamber side 1114 , RH chamber side 1105 (these two parts are securely mounted to each other to form a number of chambers ; there are openings on the circular face of the chamber sides (Nos. 1114 and 1105) for oil to leave the rotor and return to the oil tank (refer to Figures 75 , 76 and 79) after lubricating those chamber inner surfaces that are in touch with pistons 1108 located inside the chamber) , four oil bridges 1103 which are part of the oil path for chamber lubrication (refer to Figures 76 and 81) and press fitted on RH chamber side 1105, four parts called " oil flow limiters 1120 " (refer to Figure 80) each mounted on the outer surface of the LH chamber side between two adjacent piston chambers , each limiter being made of two major materials : a metal , acting as the structure for this component and a material capable of letting oil to flow through it to lubricate the inner surface of casing 2101 in a controlled manner , four piston rods 1118 that connect pistons 1108 to planet gear subassembly 1200 so as to synchronize the rotation of planet gears 1202 and pistons 1108, piston rod retaining rings 1119 used to secure rods 1118 to pistons 1108; circular seals 1104 , transverse seals 1115, seal springs 1116(for transverse seals 1115) , corner seals 1106 and corner seal springs 1107 mounted in recesses on the outer surface of the chamber ; a corner seal is used where transverse seals 1115 and circular seals 1104 meet each other, there are some recesses on LH chamber side 1114 and square holes that are formed when RH chamber side 1105 is mounted on the recesses of LH chamber side 1114 . These holes receive oil from the four aforementioned holes on shaft 1301 and oil flows to desired areas for lubrication (namely the inner chamber walls , piston pins 1117 and piston

surfaces in touch with the chamber and outer surface of rotor 1000 where it touches the inner surface of casing 2101) .

[0043] RH end cover assembly 4000 comprises : RH end cover 4104 and RH end cover plate 4101 which is mounted securely on RH end cover 4104 . There are some radially positioned walls inside the end cover that form separate closed areas when end plate 4101 is mounted on end cover 4104 . Also there are some openings on end cover 4104 matching in position with the longitudinal holes of casing 2101. The cooling water flowing in through the longitudinal holes enters a closed area through the openings and then leaves this closed area for other casing holes through other openings .Assembly 4000 also takes the load of rotor assembly 1000 at the bearing .

[0044] LH end cover assembly 3000 comprises : LH end cover 3105 , LH end cover plate 3102 and sun gear 3107 where both plate 3102 and sun gear 3107 are mounted securely on LH end cover 3105 , there are some walls inside cover 3105 with some openings on the cover with the same function as mentioned in the description of RH end cover assembly 4000 .The inlet for the cold water coming from the radiator or the water pump (refer to Figure 77) and the outlet for the warm water (flowing to the water pump) are located on LH end cover plate 3102 . There is an outlet at the bottom of cover 3105 for flowing oil from oil tank 2109 on casing assembly 2000 to oil pump , an inlet again at the bottom of cover 3105 for returning the excess oil to oil tank 2109 on casing assembly 2000, also an inlet is located at nearly the top of cover 3105 for guiding the cooled oil (coming from the oil cooler or the oil pump) to the oil filter 2104 (refer to Figure 77) on casing assembly 2000. There is an oil passage opening located nearly at the top of this cover (3105) to get the filtered oil from a duct on the casing (refer to Figures 76 and 78) where the oil comes in through the opening to a radially positioned hole on LH end cover 3105

(refer to Figure 76) and goes for the lubrication of the bearing on cover 3105 (refer to Figure 77) and for the radial hole on main shaft 1301 in order to lubricate the other parts of the engine (refer to Figure 75) . A proper hole for filling the oil tank has been considered near the top of assembly 3000 (refer to Figure 75) . The hole is covered with "oil refill hole cap 3101 " . Also there is an oil pressure sensor 3106 on the top of cover 3105 right above the oil passage opening (refer to Figure 76) .

[0045] Casing assembly 2000 comprises : casing 2101 , spark plug 2102 , oil filter 2104 ,oil filter adapter 2103 , oil tank 2109 , oil tank strainer 2108 , exhaust gas outlet 2105 and air-fuel mixture inlet 2111. There are many longitudinal holes on casing 2101 for flowing cooling water , also there are many radially positioned holes (refer to Figures 75 and 78) on the top of the inner surface of casing 2101 close to LH end cover 3105 for the lubrication of planet gears 1202 and sun gear 3107 . The mentioned holes get the filtered oil from a duct on the top of the casing where the filtered oil directly enters after coming out of oil filter 2104 . This duct also supplies oil to LH end cover assembly 3000 .The oil in the casing returns to the oil tank via an opening on each side of the casing at the bottom (refer to Figures 75 and 79) .There are three holes on casing 2101 matching the holes on LH end cover assembly 3000 (i.e. oil outlet and excess oil inlet at the bottom and oil inlet nearly at the top) . The exhaust outlet 2105 and air-fuel mixture inlet 2111, oil tank 2109 and strainer 2108 are all mounted on casing 2101, oil filter 2104 is mounted on casing 2101 using a conventional adaptor called oil filter adaptor 2103 . Both RH end cover assembly 4000 and LH end cover assembly 3000 are fixed to casing 2101 . Eight fixing holes (four on each side) are considered near the middle of casing 2101 for fixing the engine to its support .Also a suitable bolt called " oil tank drain bolt 2110" is positioned at the bottom of oil tank 2109 to drain the used oil (refer to Figure 75).